

ON THE MYOLOGY OF ORYCTEROPUS CAPENSIS  
AND PHOCA COMMUNIS. By PROFESSOR HUMPHRY.  
(Pl. III. IV. V. VI.)

I PROPOSE to give a brief description of the muscles of these two animals together, because I have lately had an opportunity of dissecting them both; and there are some advantages in doing so. My attention has been chiefly directed to the muscles of the limbs<sup>1</sup>.

Though so dissimilar in their habits the two animals are alike in the want of definition between the limbs and the trunk, owing to the manner in which the proximal parts of the limbs, which are short, are enveloped in folds of skin passing over them from the trunk, obscuring their outlines, and limiting the range of their movements. Thus, in both, the skin passes from the side of the body straight across to the elbow, making the forearm to appear the first segment of the limb; and the folds between the digits extend in *Orycteropus* as far as the second phalanges, and in *Phoca* even beyond the phalanges. In the case of the hinder limb, the thigh, in *Orycteropus*, is bent upon the abdomen and obscured by a fold of skin passing from the trunk directly to the knee; while another fold passes from the tail and hinder part of the pelvis, over the back of the leg, and reaches almost to the heel. In *Phoca* the knees are bent up beneath the abdominal muscles and the two hinder limbs are enclosed with the tail for some distance, in one fold, so as to form a flattened termination to the animal, reminding us, not a little, of the tail of a Cetacean; the wing-like processes of which might seem to be represented by the laterally expanded feet of the Seal. Both the Anteater and the Seal are furnished with long strong claws, those of the Anteater being

<sup>1</sup> I am not aware that the muscles of *Orycteropus* have been described. They are scarcely touched upon by Rapp, *Anatomische Untersuchungen über die Edentaten*. Tübingen, 1858, or by H. F. Jäger, *Anat. Untersuch. des Orycteropus Capensis*. Stuttgart, 1837. The muscles of the Seal have been more or less fully described by Meckel, Duvernoy, and others.

particularly thick and strong to enable it to burrow rapidly in the earth. In both the bones of the limbs are thick, hard and strong, with rough strongly-developed processes for the attachment of muscles; the olecranon is very large, the tibia and fibula are confluent above, though separate below; the pelvis is prolonged backwards, and the obturator holes, especially in the Seal, are large.

There are, however, some marked differences.

In the Seal the terminal parts of the limbs, especially of the hinder limbs, are large, and spread out fan-like, the digits being thin, long, of nearly equal length, and in the same plane; and the size of the fan is increased or diminished, in each foot, chiefly, by the distancing or approximating of the other digits to the first, and the lateral movement of the digits therefore increases from the first to the fifth. The dorsal and plantar surfaces of the terminal parts of the hind limb are in the same plane with those of the leg; the projecting part of the heel-bone, which is small, is drawn forwards or upwards, and the hinder part of the astragalus, carrying the groove for the flexor tendon of the toes, is drawn up with it and projects nearly as far. The lumbar and hinder five or six dorsal vertebræ are constructed so as to admit of full antero-posterior movement; whereas the iliac bones are short and directed outwards, presenting flat surfaces anteriorly; and the ischiatic bones, though long, are slender, showing that the muscles which pass from the pelvis to the short thighs are small. These features have, of course, relation to the fact that the propulsion of the animal is effected not, as in ordinary mammals, by the movements of the limbs upon the pelvis, but rather, as in the fish, by the movements of the hinder part of the vertebral column upon the rest of the trunk, the limbs of the Seal serving chiefly, like the tail-rays of the fish, to give width to that part of the column. In the Anteater the distal segments of the limbs are short, the bones being thick and strong, with many accessories or sesamoids. The digits are compressed together, and are not all in the same plane, the two lateral digits (1st and 5th) in the hind limb, and the 5th (the 1st is wanting, there being only 4) in the fore limb being shorter and placed, plantad and palmad with

regard to the other three. The sole and the dorsum of the foot in the hinder limb are at right angles with the leg; and the heel is large and projects backwards. The lumbar and dorsal vertebræ admit of but little movement; whereas the large iliac and ischiatic bones indicate the greater size of the muscles passing from them to the thighs, and the greater power of movement of the limbs upon the pelvis. The clavicles are present, though the coracoid parts of the scapulæ are small as they are in the Seal. The tail is long, thick and strong.

#### *Muscles of Skin.*

The *Platysma myoides*, in *ORYCTEROPUS*, was very strong and of great extent. In the middle of the neck it was thickest and narrowest. Traced forwards it expanded and became thinner as it approached the side of the head, and divided into two bands, of which one passed along the side of the lower jaw, and terminated in the thick part of the lower lip, reaching nearly to its margin, and served as a *depressor labii inferioris*. The other, or supra-maxillary band, broader than the infra-maxillary, covered the superior maxillary bone, and had extensive attachments to the lower margin of the orbit. Its lowermost fibres were continued forwards, as the *levator labii superioris et alæ nasi*, to the side of the snout, expanding in the upper lip and on the nostril, and serving to give tension to the lip and to dilate the nostril. The supra and infra-maxillary portions were connected, soon after their separation, by a broad band of fibres passing between them. (Pl. III.)

Traced backwards from the middle of the neck the platysma soon divided into two broad bands, of which one (a 'sternal' band) passed along the inferior surface of the sternum, to its hinder end, running parallel with the corresponding band of the opposite side. The other, or 'brachial,' band, extended down the fore part of the arm and expanded upon the fascia of the outer, or radial, side of the upper half of the forearm.

The fibres of the muscle crossed, to some extent, in the middle; some of the sternal fibres passing, behind the brachial fibres, to the supra-maxillary portion, and some of the brachial fibres crossing superficially to the sternal fibres, and reaching

the infra-maxillary portion. There was thus a direct continuity of fibres from the lower lip to the forearm; and the movements of the forearm might seem to have had an effect upon the lips and the nostril. This was however, doubtless, in great measure, prevented by the absence of any distinct sheath and by the coarse intermuscular tissue, as well as the muscular fibres themselves being continuous with the tissue of the skin on the one side, and with the subjacent cellular tissue on the other.

This extension of the platysma forwards and more especially downwards to the forearm is a good example of what we so frequently find and must always bear in mind in comparing the muscles in different animals, viz. that a structure which is muscular in one animal may be tendinous or fibrous or even areolar in another. These extensions of the platysma in the orycteropus are merely the result of a development into muscles of the fibrous or areolar tissue which usually constitutes the more or less well-defined connections of the muscle with the subcutaneous structures of the chest, arm, and forearm in man and other animals. In the terminal parts of the limbs certain muscles, more especially those of the lateral digits (the 1st and 5th, which, be it remarked, are those most frequently observed to fade or disappear altogether), are often, as in the Seal (p. 317), represented only by fibrous bands. The developmental differentiation has advanced no further in them.

In PHOCA the *Platysma* was scarcely discernible, being blended with the fibres of the *Panniculus carnosus* which was large, covering the whole of the back from the head to the sacrum. Its fibres met in the middle line, were for the most part tendinous near the middle line, and were closely connected with the tendinous fibres of the trapezius and with the ligamentum nuchæ. Extending laterally they were muscular, and formed a sheet of considerable thickness. They then passed over the sides of the trunk and terminated in tendinous fibres which were blended with the cellular tissue and skin of the under part of the chest and abdomen. The hindmost fibres covering the hinder part of the abdominal wall and crossing the origin of the pectorals, formed the outermost layer of the fold beneath which the knees are drawn up in the usual position of the animal. On the shoulders they were lost in the superficial fascia and skin, being closely connected with the pectorals in

the axillæ<sup>1</sup>. In the neck they covered the whole under surface, interlacing in the middle line, and closely connected with the trapezius and sterno-mastoid. Anteriorly, they passed over the occiput upon the vertex and superciliary regions, and were continued over the cartilaginous tube of the ear upon the face and into the lips.

The *Panniculus* in ORYCTEROPUS extended over the sides of the abdomen, the pelvis, buttock, and the outer sides of the thighs and knees. Its fibres were closely connected with those of the latissimus dorsi, obliquus ext. and the lower margin of the pectoralis major. (Pl. v.)

Between the infra and supra-maxillary portions of the platysma in ORYCT. was seen the *Buccinator*, passing from both the maxillæ and expanding upon the buccal mucous membrane; and its supra-maxillary portion was crossed by a delicate slip, the *Levator anguli oris*, passing from the side of the superior maxilla to the skin near the angle of the mouth. (Pl. III.)

Emerging from beneath the supra-maxillary portion of the platysma, just above the *Levator labii*, was a distinct strap-like muscle, representing perhaps the *Compressor narium*. It extended from the maxillary bone to the upper part of the snout and had the effect of moving the snout upwards, or forwards when the head was down: it may be called *Levator nasi*. (Pl. III.)

In PHOCA most of these muscles of the lips were strongly developed. The *Levator labii superioris et alæ nasi* was very large, passing from the margin of the orbit, above the supra-maxillary foramen, to the fore part of the upper lip where it invested the whisker bulbs. The *Compressor narium* was also large. Passing from over the bridge of the nose, where it was confluent with its fellow, and descending from the frontal bone it was spread out on the side of the nostril and blended with the *Levator labii*. The foremost fibres, covering the extremity of the nasal cartilages, passed obliquely backwards, crossing the others. *Levator anguli oris* passed from beneath the fore part of the orbit to the angle of the mouth. The *Levator labii*

<sup>1</sup> This connection representing the distinct slip from the panniculus, which in the rat and many other animals passes with the pectoral muscle, in the axilla, to the humerus.

*superioris* passed from beneath the supra-maxillary foramen into the margin of the lip. The *Depressor labii superioris* was of large size, passing from over the incisor teeth into the tissue about the whisker bulbs. Some of the fibres, distinct from the rest, ran inwards to the nostril. *Levator* and *Depressor labii inferioris* very small. (Pl. VI.)

It will be perceived therefore that in *Orycteropus* the facial muscles are much connected with the platysma, and their development has relation chiefly to the movements of the thick truncated snout; in *Phoca* they are more connected with the facial bones, and are directed more to the movements of the upper lip and its whiskers.

In both animals the *Orbicularis oris* was feeble; the *Orbicularis palpebrarum* and *Corrugator supercilii* presented nothing remarkable.

The muscles of the ear in the two animals presented a contrast corresponding with the difference in the size of the external ear. Thus,

In *ORYCTEROPUS* several large muscles passed to the well-developed cartilage and skin of the external ear. The *attrahens* arose (1) from the lower jaw just beneath the condyle, (2) from behind the margin of the orbit, and (3) from above the margin of the orbit, where it was connected with the orbicularis. The fibres from these sources converged to the under and fore part of the ear. The *Depressor* was a slip detached from the sterno-mastoid and traceable to the sternum. It ascended beneath the platysma to the lower part of the ear<sup>1</sup>. The *Retrahens* arose from the middle line of the nape of the neck. The hinder fibres passed from those of the opposite side at an acute angle, the middle more transversely, and the foremost were in contact with those of the following muscle. The fibres converged to the back of the ear. The *Attollens*, from the middle line over the hinder part of the head, passed to the upper surface of the ear. It terminated in the middle in a defined edge; but some of its foremost lateral fibres were con-

<sup>1</sup> The external jugular vein crossing the sterno-mastoid entered the angle between it and this muscle, passed beneath the latter and then descended in front of the clavicle, dipping into the subclavian vein in the triangular space between the clavicle and the subclavian muscle. (Pl. IV.)

tinued, above the ear, to the upper margin of the orbit, there blending with the orbicularis and the attrahens. (Pl. v.)

In PHOCA the tubular cartilage of the ear as it passed upwards to the external orifice in the skin was covered by the fibres of the panniculus which were slightly attached to it, and would serve to draw it backwards. There was also a distinct *attrahens* passing from the zygoma, above the glenoid cavity, upwards, to the external auditory tube near its outlet, and an *attollens* passing from over the orbit to the same part. These were, however, feeble. (Pl. VI.)

#### FORE LIMB.

*Pectoralis major* (ORYCT.) large, had no attachment to the clavicle, but arose from the whole of the front of the sternum, and from several costal cartilages behind the sternum. Its fore part was thick like the clavicular portion of the human pectoralis. Its hinder part was much thinner, and was continuous with the obliquus abdominis and the latissimus dorsi. The greater number of the fibres converged to the external bicipital ridge: some of the anterior portion joined the tendons of the biceps and the fore part of the deltoid, and were inserted with them into the tubercle of the radius; and some of the hindmost fibres, separating from those which ran to the humerus, passed to the forearm and were lost in the tissue between the fascia and the skin of the inner surface of the upper half of the forearm. (Pl. IV.)

In PHOCA the *Pectoralis major* covered nearly the whole of the under surface of the abdomen, chest, and hinder part of the neck, the fibres converging to the fore part of the axilla, and being inserted into the broad prominent ridge descending from the great tubercle of the humerus in front of the bicipital groove. It arose in two divisions. The first, the pectoralis proper, attached to the long episternum, the sternum, and two costal cartilages. The hinder part of this division formed a fascia expanding upon the forearm and carpus. The second division arose from the linea alba and the pubes, and also from the margin of the ilium, covering the fibres of the external

oblique which were seen running transversely between the iliac and the pubic portions<sup>1</sup>. (Pl. VI.)

*Pectoralis minor* (ORYCT.) small, flat, beneath pect. maj., from two costal cartilages, near the hinder part of the sternum, to the outer bicipital ridge.

*Subclavius* (ORYCT.) was a large muscle arising from the first and second costal cartilages and the adjacent part of the sternum beneath the pectoral. It ran outwards and was attached by a few fibres to the under surface of the outer part of the clavicle; but the greater part of it passed beneath the clavicle, over the coracoid and coraco-acromial ligament, on to the dorsum of the scapula where it was inserted into the fascia covering the supra-spinatus as well as into the margin of the acromion (Pl. IV.).—(PHOCA) thin from the margin of the sternum, opposite the 2nd, 3rd, and 4th ribs and inserted into edge of the 1st rib near the point corresponding with the insertion of the scalenus anticus in man. The artery of the fore limb crossed its insertion. It was in close contact with the scalenus; indeed some of its fibres joined that muscle. (Pl. VI.)

*Latissimus dorsi* (ORYCT.) arose from the six lower dorsal spines beneath the trapezius and from the lumbar fascia. It was also closely connected with the panniculus. Its foremost fibres were blended with those of the triceps cubiti arising from the angle of the scapula; and the rest of its fibres were inserted into the hinder bicipital ridge of the humerus. (Pl. V.) In PHOCA it was in two portions. One of these arose from the dorsal spines under the trapezius; it overlapped considerably the posterior angle of the scapula and the origin of the triceps, but was not connected with either. It passed with the teres, as usual, to the posterior bicipital ridge. The other portion arose from the lumbar fascia and two or three ribs. Its fibres did not take quite the direction of the former portion, but crossed beneath the pectoralis to be inserted beneath it into the anterior bicipital ridge<sup>2</sup>. (Pl. VI.)

<sup>1</sup> In Pteropus and in the Frog the pectoral extends over the surface of the abdomen to the pubes.

<sup>2</sup> I did not find that it extended so far upon the arm and forearm as Meckel describes. In a male subject in our dissecting-room lately, Mr Carver found the latissimus dorsi arising further forwards than usual (from the four lower ribs);



*Trapezius* in ORYCT. was disposed as in man, except that its upper part was covered by the retractor auris, and it was not attached to the clavicle, but only to the acromion and the spine of the scapula. In PHOCA the hinder fibres passed over the hinder part of the deltoid and were attached to the back part of the spine of the scapula: the middle fibres were partly confluent with those of the deltoid, and partly attached to the scapular spine: the foremost fibres passed over the scapula, parallel with and close to the deltoid, and were inserted, near the latter, into the outer tubercle of the humerus, and the ridge descending from it. Some of its fibres were in close contact with if not continuous with, those of the panniculus.

The Trapezius and the Deltoid may be regarded as one muscle often separated by the clavicle and the spine of the scapula. In many animals where the clavicle is absent their clavicular portions are continuous; and in the Seal their scapular portions are also to some extent continuous. They form, indeed, one of the divisions, or sectors, of a large, circular, more or less, continuous sheet which, in these and most other mammals, converges from the trunk upon the humeral segment of the limb and has its chief attachment to that segment; though it, or portions of it, may extend below the humerus and reach even to the carpus or tarsus and the digits. Peripherally, this sheet is attached to the various surrounding parts of the trunk, including the head, the sternum, and, it may be, the linea alba and pubes, the ribs, the pelvis, the lumbar, dorsal and cervical spinous processes. It is the chief agent in moving the limb upon the trunk. It may form an almost continuous circular sheet; or it may be, and usually is, split into three radiating segments, which constitute the following muscles: (1) Trapezius with the Cervico-humeral and Deltoid. (2) Pectoralis major and minor. (3) Latissimus dorsi. In the hind limb the radiating segments corresponding with these are composed of Glutæus, with Sartorius and Tensor vaginæ femoris, Gracilis and, perhaps, Psoas magnus.

A second or inner circle, enclosed by the preceding, radiates from the base of the scapula to the trunk and, sometimes, to the head. It consists of the Serratus magnus anticus, the Levator scapulæ, and the Rhomboidei. There is no correspondent to this circle in the hinder limb, the pelvis not being, like the scapula, moveable upon the trunk.

*Cervico-humeral* (ORYCT.) arose from the transverse process of the atlas and passed to the part of the acromion where it and the foremost fibres (those arising from the 9th rib) passed, on the front of the biceps tendon, to the fore part of the bicipital groove. The same thing has been observed by others.

blends with the spine of the scapula, and was there inserted superficially to the trapezius. (Pl. IV.) In PHOCA it arose from the same point in two portions, of which one passed to the outer tubercle of the humerus near the trapezius, while the other passed to the anterior angle of the scapula, and overlapped the supra-spinatus<sup>1</sup>. (Pl. VI.)

*Levator scapulæ* (ORYCT. and PH.) from the 2nd, 3rd, 4th, and 5th cervical transverse processes to the base of the scapula above the spine, and to the fascia covering the supra-spinatus. The hinder fibres were continuous with those of the next muscle, and inserted with them into the inner surface of the base of the scapula. (Pl. V. VI.)

*Serratus magnus* (ORYCT. and PH.) disposed much as in man, except that it formed a continuous sheet with the levator scapulæ.

*Rhomboideus minor* (ORYCT. and PH.), a long muscle from the occipital crest, and the mesial cervical ligament to the base of the scapula near the spine. *Rhomboideus major* much as in man. (Pl. V. VI.)

*Deltoid* (ORYCT.) consisted of two parts—one, arising broad and muscular from the anterior edge of the outer part of the clavicle, descended, tapering, along the front of the arm, joined the biceps after being separated from it by the pectorals, and was inserted with it into the tubercle of the radius. The other part passed from the outer margin of the acromion and the spine of the scapula, as usual, to the rough ridge on the outer side of the humerus. (Pl. IV.) In PHOCA it arose from part of the supra-scapular fossa, in the place of the infra-spinatus, and was inserted as usual. Some of its fibres were, as above said, confluent with those of the trapezius. (Pl. VI.)

*Supra-spinatus* (ORYCT.). Its tendon was inserted some way down beneath the great tubercle of the humerus occupying a groove which was external to that for the biceps, and looked like a second bicipital groove; (PH.) disposed as usual.

<sup>1</sup> It did not extend to the mastoid process of the temporal, though Meckel (*Vergleichende Anatomie*, III. 476) describes it as so doing, and regards it as representing the cleido-mastoid and the clavicular part of the trapezius. It would seem more likely to be a portion detached from the trapezius and attached to the large transverse process of the atlas.

*Infra-spinatus* and *Teres minor* (ORYCT.) nothing particular; in PH. very small, and almost confined to the under surface of the scapular spine.

*Teres major* (ORYCT.) arose from the inner surface of the angle of the scapula, the whole of the posterior margin being occupied by the triceps: (PH.) from the external surface of the angle of the scapula. It was attached to the humerus, as usual, in both.

*Sub-scapularis* (ORYCT.) from the part of the inner surface of the scapula not occupied by the teres and from the wide post-coracoid ligament. Its tendon passed on the outside of the capsule of the shoulder-joint to the inner tubercle of the humerus; (PH.) as usual.

*Coraco-brachialis* (ORYCT.) from the coracoid and post-coracoid ligament<sup>1</sup> to the inner surface of the humerus as low as the supra-condyloid hole; (PH.) absent, as well as the pectoralis minor.

*Biceps* (ORYCT.) had only one origin, viz., from the middle of the fore part of the coracoid process. Its tendon passed directly *over* the capsule of the shoulder-joint, between the tubercles of the humerus, and was inserted into the tubercle of the radius, being previously joined by the clavicular portion of the deltoid. It had no connection with the fascia or muscles of the forearm; but a few of its fibres passed with those of the brachialis anticus to the ulna (Pl. IV.). (PH.) From the process (the short coracoid) projecting over the glenoid cavity. Its tendon did not pass through the shoulder-joint; though at one small point it was exposed to the synovial cavity. It was attached to the tubercle of the radius, not sending any fibres to the ulna. (Pl. VI.)

The more constant origin of the biceps seems to be from the coracoid. In the Frog and the Bird it has no connection with the scapula. Where the coracoid is small there is usually only one tendon. In the Dog I found a slight furrow in this tendon suggestive of a division into two. When the coracoid runs out into a process of any considerable length the tendon is divided into two,

<sup>1</sup> The post-coracoid notch is very wide in *Orycteropus*, and occupied by a ligament (like that occupying the obturator hole) between the sub-scapularis and the supra-spinatus.

as in man. The biceps may also, as in the Bird, derive a slip from the humerus, or from a portion of the external circular muscle described above (p. 298) as moving the fore limb upon the trunk. Thus in *Orycteropus* the clavicular part of the deltoid joins the biceps.

*Brachialis anticus* arose, in both animals, from the outer side of the shaft of the humerus behind the ridge descending from the outer tubercle, there being, as seems commonly the case, no portion corresponding with that which in man descends from the inner side of the insertion of the deltoid. It passed to the coronoid process of the ulna. In *Orycteropus* it received some fibres from the biceps; and in the Seal a bundle of its foremost fibres passed to the biceps, and were inserted with it into the tubercle of the radius.

*Triceps extensor cubiti* (ORYCT.) arose, as in man, by two portions from the hinder surface of the humerus and from the posterior costa of the scapula, just behind the glenoid cavity, and, further, by two additional divisions, from the whole of the posterior costa. Of these one was very large, occupying the greater part of the costa, while the other was smaller and near the angle and confluent, to some extent, with the latissimus dorsi. Some of the fibres of the latissimus dorsi also ran parallel with and close to, or conjoined with, those of the humeral portion of the triceps on the inner side of the arm. There were thus three divisions from the posterior costa of the scapula. They were more or less united; but it could be seen that the middle and largest passed over the end of the olecranon separated from its smooth surface by a bursa, as in man, and was inserted into the rough ridge just beyond it: the hindmost division, from the angle of the scapula, was inserted on the inner side of the olecranon; and the post-glenoid division was inserted on the outer side of the olecranon. The division of the muscle arising from the humerus (the *post brachialis* as it might be called) was distinct from the scapular part, and was inserted into the upper surface of the olecranon, between the bursa just mentioned and the articular facet: an additional small portion (an *anconeus*<sup>1</sup>

<sup>1</sup> This origin is found not unfrequently in the human subject and has been named *Epitrochleo-anconeus*. See p. 106, of this Vol.

*internus*) passed from just above the inner condyle to the inner side of the olecranon. (Pl. v.) In PHOCA the muscle arose by four divisions, two from the humerus and two from the scapula: one from the outer surface of the posterior angle of the scapula, distinct from the trapezius, passed over the point of the olecranon sending a few fibres to it, and ran along the inferior edge of the forearm and paddle to the second phalanx of the 5th digit, serving to expand the paddle by separating the 5th and with it the other digits from the 1st: a second passed from the outer surface of the posterior costa of the scapula, behind the glenoid cavity, to the lower, or distant, part of the long posterior surface of the olecranon<sup>1</sup>: a third passed from the posterior and outer surface of the humerus, behind the outer tubercle, to the upper projecting angle and adjacent part of the hinder surface of the olecranon: a fourth passed from the posterior surface of the humerus, behind the external supracondyloid ridge, to the rough upper surface of the olecranon behind the articular surface. These four portions were all more or less blended at their insertion. (Pl. VI.)

No distinct *anconeus externus* in either animal.

*Pronator radii teres* was disposed in both as in man, except that it had no origin from the ulna. *Pronator quadratus* was small.

*Flexor carpi radialis* arose, in both, from the inner condyle of the humerus. In ORYCT. it was attached to the head of the 2nd (index) metacarpal. A small sesamoid bone was included in it where it passed over the projecting scaphoid close to the metacarpal. It sent a slip transversely, or with a slight inclination backwards, to the lower margin of the radius. (Pl. IV.) In PHOCA it was inserted chiefly into the base of the 1st metacarpal. Some fibres of its tendon were attached to the scaphoid; and a slip passed on to the 2nd metacarpal. (Pl. VI.)

This attachment to the 1st metacarpal in the Seal, and it was the same with the radial extensor, is favourable to the movement of the paddle, inasmuch as the osseous components of the 1st digit are the longest, largest, and most fixed of the series.

<sup>1</sup> This is very broad and easily divisible into two portions, and is described as two by Meckel (*l.c.* 528). It is rather surprising that he makes no mention of the extension to the 5th digit of the portion coming from the angle of the scapula.

*Flexor carpi ulnaris* (ORYCT.) as in man.—In PHOCA it arose exclusively from the inner and back part of the large olecranon and the surface of the ulna. It had a slight insertion into the pisiform bone ; but the greater part of its fibres terminated in two broad tendons which passed one on the superficial the other on the deep aspect of the flexor tendons. Of these the superficial crossed, beneath the palmaris longus, to the radial side of the wrist, and was blended with the tendon representing the flexor brevis pollicis : it thus corresponds with the annular ligament of man, some fibres of which are derived from the fl. c. u. The deeper tendon expanded upon the palmar aspect of the carpal bones.

*Palmaris longus* in ORYCT. was merged in the flexor digitorum sublimis.—In PHOCA it arose not from the inner condyle of the humerus but from the inner side of the olecranon where some of its fibres were continuous with those of the post-glenoid portion of the triceps. It expanded into the palmar fascia and sent a division to each of the three middle digits. These were continuous with the sheaths of the flexor tendons by their superficial fibres, and by their deeper fibres were connected with the tendons of the flexor sublimis. A strong process of its palmar expansion passed outwards to the margin of the radius, carpus and pollex. (Pl. VI.)

*Flexor digitorum sublimis* (ORYCT.) comparatively small and imbedded in the much larger fl. dig. profundus. It arose from the internal condyle of the humerus and expanded at the wrist into a broad tendon which was superficial to the annular ligament, was connected with the subcutaneous cellular tissue and was the only representative of the palmar fascia. From this expansion a tendon passed to each of the four digits. Over the metacarpo-phalangeal joints each of these tendons sent off a superficial expansion which blended with the sheath and cross-bands of the deep flexor tendon ; while the deeper portion of the tendon split into two, which separated, embraced the deep flexor, and passed behind it to be inserted into the base and sides of the second phalanx. (Pl. IV.) In PHOCA it was a very thin delicate muscle, arising from a thin fascia on the surface of the flexor profundus. It terminated in three delicate tendons,

which passed to the three middle digits and were disposed as usual. They received a few fibres from the *palmaris longus*.

*Flexor digitorum profundus* (ORYCT.) very large, arising from the inner condyle, the interosseous ligament, and a considerable part of the palmar surface of the radius and ulna, so occupying the place of the *fl. long. pollicis* in man and much of that of the *fl. subl. dig.*, and forming a channel in which the latter muscle was situated. Its numerous fibres ended in a broad tendon which passed under the thick annular ligament, separated from it and from the subjacent bones by loose cellular tissue, and divided into four tendons inserted into the terminal phalanges of the four digits. Each of these was divided by a longitudinal slit near its insertion. (Pl. III.) In PHOCA its distribution was much the same; except that the greater proportion of the fibres arising from the radius passed to the 1st digit, constituting a representative of the *flexor longus pollicis*, which did not exist as a distinct muscle.

The typically complete arrangement of the long flexors of the digits appears to be, as we find it in man, in three layers superimposed upon one another, viz. a superficial layer, consisting of the *palmaris longus*, which forms the palmar fascia, and is connected with the sheaths of the deeper strata and with the fibrous tissue of the cutis; a middle layer, consisting of the *flexor sublimis digitorum*, which passes to the 2nd phalanges of the digits; and a deep layer, consisting of the *flexor profundus digitorum* and the *flexor longus pollicis*, when it is present, which pass to the terminal phalanges. Of these the last, or deepest, layer is the most constant, though it sometimes fails to pass to the first digit. The other two vary a good deal in the degree of their development, being sometimes very small, or more or less imperfect, or blended, as in *Orycteropus*, or partially united, as in *Phoca*; or the middle layer may be blended with the deepest layer. Often they fail to extend to the 1st and the 5th digits, as in *Phoca*, or to one of them. The comparison of them with the corresponding muscles in the hind limb is interesting (p. 316).

*Lumbricales*, in ORYCT., passed from the palmar surface of the broad tendon of the preceding muscle to the radial sides of the four digits.—In PHOCA they were absent.

*Flexor minimi digiti*. In PHOCA there was a distinct tendon passing from the internal condyle of the humerus to the unciform bone, where it was blended with tendinous fibres (*fl.*

brevis minimi digiti) passing to the second phalanx of the 5th digit.

*Abductor minimi digiti* (ORYCT.) from ulnar side of metacarpal to ulnar side of first phalanx.

*Interossei* (ORYCT.), three *palmar*—one on the ulnar side of 2nd digit and one on the radial side of each of the 4th and 5th digits. They were all attached at the bases of the metacarpals; and the origin of that of the 5th digit extended over the others. There were four *dorsal* attached to the sides of the metacarpals, though still rather on the palmar than the dorsal aspects; one passed to the radial side of each of the 2nd and 3rd digits and one to the ulnar side of each of the 3rd and 4th digits. There was therefore an adductor and an abductor of each digit. In PHOCA there was also an abductor and adductor of each digit; but all were on the palmar rather than the dorsal aspect.

The typical arrangement of these deep muscles (*interossei*, adductors and abductors) I think is as follows: a muscular belly lies upon each side of each metacarpal, the two bellies being approximated, or united, on the palmar surface of the metacarpal at the middle and proximal parts. Towards the distal part they diverge; and each is attached to the side of the sesamoid body, so constituting a short flexor, while some of the fibres pass upon the sides and dorsal aspect of the phalanges. These have the effect of abducting or adducting, as the case may be, and, to a certain extent, of extending the digit<sup>1</sup>. In the instance of the 1st and also in that of the 5th digit, but of the 1st more particularly, the sesamoidal or flexor portions are more distinct from the phalangeal or abductor and adductor portions than in the remaining digits. Hence we find, not unfrequently, in the case of one or other, or both, of these digits an abductor and an adductor separate from the short flexor. In the remaining digits, indeed (and it may be so in the first and fifth), the sesamoidal portions are often wanting or nearly so. Moreover, some of the fibres passing to the phalanges may, and often do, extend further upon the palmar surface of the limb, gaining attachment to (*i.e.* origin from) the carpals or to some other of the metacarpals besides their own. This is particularly the case with the muscles passing to the ulnar side of the 1st and to the radial side of the 5th digit. These two not unfrequently meet and so cover the others, and their efficiency in approximating the two marginal digits is thus materially increased. The muscles passing to the radial side of the 4th digit and to the

<sup>1</sup> This arrangement is very clearly seen in the Rabbit, the flexor portions passing to the sesamoid bones being distinct from the abductor and adductor portions passing to the sides and dorsum of the phalanges.



ulnar side of the 2nd often do the same though to a less extent. The others, that is, those passing to the ulnar sides of the 3rd and 4th and to the radial sides of the 2nd and 3rd digits, extend somewhat upon the dorsal aspects of their respective metacarpals and may acquire an attachment to the adjacent metacarpals. In other words, those muscles which pass upon the palmar aspect, and may be supposed to be associated with the flexor muscles in their action, have the effect of approximating the digits towards a line corresponding with the axis of the 3rd digit; whereas the muscles which pass upon the dorsal surface, and may be supposed to be associated with the extensors in their action, have the effect of abducting the digits from that line. Thus the palmar interossei cooperate with the flexors in the combined movements of flexion and approximation of the digits, while the dorsal interossei cooperate with the extensors in the combined movements of extension and separation of the digits; and we thus find a reason for that arrangement of the interossei, which is very regular and which is very marked in the human hand where the lateral movements are free, though it is less marked in most of the lower animals. Indeed, in many of the latter the interossei are limited to the palmar aspect or extend very little towards the dorsum.

*Supinator longus* arose in both from above the internal supra-condyloid ridge. In ORYCT. it formed a prominent ridge at the bend of the elbow; and its tendon was partly expanded upon the back of the carpus and metacarpus. (Pl. III.) The deeper fibres of the tendon were attached to the ridges of the radius projecting between the extensor tendons; and some of them were inserted into the trapezium. In PHOCA it was inserted into the projecting upper margin of the radius near the wrist<sup>1</sup>.

*Supinator brevis* in both, as in man, but larger, and extending further down the radius.

*Extensor carpi radialis*, one muscle arising from the external supra-condyloid ridge beneath the preceding. In ORYCT. it was inserted into the radial side of the 3rd metacarpal in the position of the ext. c. r. brevior of man.—In PHOCA it divided as it passed over the wrist into two tendons of unequal size. Of these the smaller was attached to the radial side of the 1st metacarpal, and the larger to the radial side of the 2nd metacarpal. (Pl. VI.)

<sup>1</sup> There was no trace of the second deeper portion of this muscle described by Meckel (*l. c.* 535).

*Extensor carpi ulnaris* (ORYCT.), from the outer condyle, from the wide outer surface of the olecranon and from the shaft of the ulna. Its tendon divided to be inserted into the 4th and 5th metacarpals, the larger portion going to the former.—In PHOCA it had a slight origin from the olecranon, in addition to that from the outer condyle, and was inserted into the ulnar margin of the 5th metacarpal, serving to adduct this digit and so to expand the paddle.

*Extensor communis digitorum* (ORYCT.) consisted of four tendons derived from two bundles of muscle which arose, close together, from the outer condyle of the humerus. The tendons were joined at the wrist and passed to the four digits, each sending the deeper portion of its substance to the base of the second phalanx while the more superficial part ran to the base of the terminal phalanx. In PHOCA there were two muscles arising from the external supra-condyloid ridge, one above the other. Their tendons passed through distinct grooves on the back of the radius; and each supplied the outer four toes. The one (*extensor communis digitorum*) arose rather the higher, passed as one tendon over the carpus, and expanded web-like on the metacarpus; and its four tendons ran along the radial side of the back of the phalanges; so that it served to adduct the several digits to the pollex as well as to extend them. The other (*extensor secundus digitorum*) arising lower than, and lying on the ulnar side of, the communis, divided into four tendons about the middle of the forearm. These crossed beneath the tendons of the primus (two of them at least), and ran along the ulnar side of the back of the phalanges; so that they served to abduct the digits from the pollex as well as to extend them. The tendon to the 5th digit was larger than the others. (Pl. VI.)

*Extensor annularis* in ORYCT. arose from the outer condyle, external to the ext. communis. It had a strong tendon which ran beneath the tendon of ext. c., sent off a band to the base of the 1st phalanx of the 4th digit and ran on to the ulnar side of the base of the 2nd phalanx, close to the insertion of the deeper portion of the tendon of the ext. c.

*Extensor minimi digiti* (ORYCT.) arose from the outer con-

dyle external to the preceding and was inserted, much in the same way as it, into the ulnar side of the 1st and 2nd phalanges of the outer two digits.

*Extensor indicis* (ORYCT.), from the surface of the ulna beneath the ext. communis, divided into two tendons, of which one ran to the ulnar side of the first phalanx of the index or 2nd digit, and the other to the radial side of the first phalanx of the middle or 3rd digit.

*Extensor ossis metacarpi pollicis* (ORYCT.), a large muscle arising from the back of the radius and ulna, in the usual position of the extensors of the pollex in man, and passing superficially to the ext. c. radialis to be inserted into the trapezium which is the only rudiment of the pollex and which lies on the radial side of the base of the index metacarpal. In PHOCA it arose from the outer surface of the olecranon, passed in a deep groove on the edge of the radius, and was inserted into the radial margin of the proximal end of the 1st metacarpal, distinct from and on the radial side of the tendon of the ext. c. radialis.

*Extensor primi internodii pollicis* (ORYCT.), absent. In PHOCA it arose from the olecranon beneath the preceding, passed in a groove of the radius, close to but distinct from the extensor digitorum communis, and was inserted into the back of the first phalanx of the pollex.

*Extensor secundi internodii pollicis*, absent in both.

The typical arrangement of the extensors of the digits is in three sets of muscles. The first set is represented by the *Extensor communis digitorum* arising from the radial side of the limb and passing over the backs of the phalanges to the terminal phalanges of the four outer digits. The tendons lie on the middle of the digits and extend on their radial and partly also on their ulnar side. The second set is represented by the *Extensor secundus* of the Seal and by the separate extensors of several digits in *Orycteropus* and other animals, and the extensor minimi digiti of man<sup>1</sup>. These lie on the ulnar side of the common extensor; and their tendons pass more

<sup>1</sup> A small muscle lately pointed out to me by Mr Carver in our dissecting room, in the body of an adult man, was probably also a representative of this extensor secundus. It arose as a flat fleshy belly from the lower margin of the radius, on the ulnar side of the groove for the extensor of the terminal phalanx of the pollex, and ended in a thin tendon which joined the ulnar side of the extensor tendon of the 3rd digit.

on the ulnar side of the phalanges. Such of them as cross the tendons of the common extensor pass beneath them in so doing. This second set appears to correspond with the extensor brevis digitorum pedis. The third set consists of the muscles which pass from the ulnar side obliquely across, beneath the two preceding sets, to the first and second digits, commonly to the first only, on the radial side. This set appears to correspond with the extensor longus pollicis and some of the peronei in the hind limb.

The extensor tendons differ from the flexors in passing to the lateral as well as the median parts of the phalanges, which enables them to act as abductors and adductors as well as flexors of the digits; and it may be remarked that these lateral movements are associated with extension rather than flexion, attain their maximum in the extended and are at their minimum in the bent position. This is very obvious in the human hand.

#### HIND LIMB.

*Psoas magnus* (ORYCT.) much as in man. In PHOCA it arose from the lumbar transverse processes and last rib. The greater part of its fibres were inserted into the brim of the pelvis in front of the hip-joint; some of them were continued down the inner side of the thigh, and inserted into the large rough supra-condyloid ridge. These were chiefly the fibres that arise lowest down, and which had therefore a nearly horizontal course<sup>1</sup>.

There is no distinct internal trochanter in the Seal, and none of the fibres either of the psoas or iliacus internus are inserted in that situation.

*Psoas parvus* in each was large, arose from the bodies of the lumbar vertebræ and, slightly, from the edge of the hindmost rib, and was inserted into a projecting process of the pubes internal to the psoas magnus.

*Iliacus internus* (ORYCT.) extended lower down the femur than in man. In PHOCA it was represented only by a few fibres passing from the anterior surface of the ilium (internal to the attachment of the large quadratus lumborum which occupies almost all this surface of the ilium), and joining the psoas in the thigh<sup>2</sup>.

<sup>1</sup> It may be a question whether these fibres, arising low down and passing to the femur, appertain to the psoas or to the iliacus. In the Rabbit a muscular mass arising from the same part (the body of the last lumbar vertebra) is distinct from the psoas, but joined with the remainder of the iliacus which arises from the outer surface of the ilium.

<sup>2</sup> Meckel describes the iliacus internus in the Seal. Duvernoy appears not to have found it; and indeed its existence as a separate muscle may be ques-

*Gracilis* (ORYCT.) very broad from the symphysis and adjacent part of the pubes, over the inner side of the thigh, expanding upon the inner side of the knee, leg, ankle, and foot. Its hinder margin, united with the semimembranosus, formed a thick band attached to the ligaments beneath the internal malleolus. (Pl. IV.) In PHOCA it was also very broad and covered the symphysis pubis, being continuous with the muscle of the opposite side. The chief direction of its fibres was transverse; but they radiated as they approached the leg, the upper fibres ascending nearly to the knee, and the lower fibres descending to the inner ankle, covering the interval between the internal malleolus and the os calcis, and extending as a fascial expansion over the plantar fascia and muscles. Many of its fibres were inserted at right angles, or nearly so, into a tendon which ran along its fore part parallel with the tibia. This tendon passing the inner ankle, was continued, on the plantar aspect of the hallux, into a tendon which represented the flexor brevis and the adductor hallucis and was inserted with them into the base of the first phalanx of the hallux; some of its fibres extending to the distal end of that phalanx. In one foot of this Seal the hinder margin of the gracilis tendon was also thick, and formed or contributed to form the superficial flexor tendon of the fifth digit.

*Pectineus* (ORYCT.) from the margin of the pubes, internal to the gracilis, over the inner side of the thigh and knee in front of the gracilis.

*Adductores* (ORYCT.), a considerable mass in three divisions, *magnus*, *longus*, and *brevis*. They arose from the lower part of the circumference of the obturator hole and were inserted into the linea aspera. Many of the fibres of the two sides met beneath the pubes behind the gracilis. In PHOCA the muscles of the front of the abdomen overhung the knee; and when these were removed a wide deep chasm was exposed between the long pubes, on the one side, and the thigh, knee, and leg, on the other. This chasm was crossed behind by a large muscle

tioned. Meckel describes the *psoas parvus* as being larger and the *psoas magnus* as smaller than I have represented them. In other respects his account coincides with that in the text. *Vergl. Anat.* III. 591.

passing from the side of the symphysis pubis to the front of the upper part of the leg and knee beneath the gracilis. It may perhaps be regarded as an *Adductor magnus*. At the fore or narrow part of the chasm were two other adductors passing from the rough processes on the front of the pubes, internal to the *psoas parvus*, to the hinder surface of the femur. (There is no *linea aspera* as well as no lesser trochanter in this animal.)

*Sartorius* (ORYCT.) small, had no connection with the ilium but arose from the hindmost rib, just external to the *psoas*, passed under the crural arch, and sent some fibres in company with the *pectineus*, over the knee. The greater part of its fibres, however, were lost in a tendinous expansion covering the *vastus internus*, and descending between it and the adductors to the *linea aspera*. In PHOCA it passed from just beneath the anterior spine of the ilium to the upper surface of the patella.

*Quadriceps* (ORYCT.) arose as in man. The *tendo patellæ* was broad and inserted into the tubercle projecting from the line of confluence of the tibia and fibula as well as into the *tuber tibiæ*. In PHOCA the muscle was large and attached to the front of the ilium above the hip-joint, also to a rough surface which seems to represent the anterior spine of the ilium, as well as to the femur.

#### BUTTOCK AND BACK OF HINDER LIMB.

*Glutæus maximus* (ORYCT.), a very broad and strong muscle arising from the whole of the crest of the ilium as well as from the sacral and several of the caudal spines. It almost enveloped the thigh. Its foremost fibres which might perhaps be called *tensor vaginæ femoris*, arising from the lower margin of the ilium beneath the ant. sup. spine, passed on to the fore and inner part of the thigh. The middle portion of the muscle was spread out over the outer side of the thigh, the knee, and the leg, reaching nearly to the heel. The hindermost fibres wound beneath those in front of them, giving a thick margin to the muscle, and reached the hinder and inner part of the thigh,

knee and leg. All these widely disposed and strong fibres were inserted into the various parts of the fascia of the thigh, knee and leg, and, as I have said, nearly ensheathed the limb. The deeper fibres of its middle part were in great measure inserted, as in man, into the projecting ridge on the outer side of the shaft of the femur; while some of them passed into the fascia covering the vastus externus, and so formed a stratum beneath the more superficial layer of the muscle. (Pl. v.)

Thus the *glutæus* acts as a powerful retractor of the whole limb, of the leg and thigh at least, and contributes to strengthen the backward movement of the foot in scrapping. In PHOCA it arose from the back of the crest of the ilium, the sacral spines, and the sacro-iliac ligaments, and was attached to the trochanter and the external supra-condyloid ridge of the femur, while its lower part expanded over the knee-joint. Some of its fibres were continuous with those of the vastus externus. (Pl. vi.)

*Glutæus medius* (ORYCT.) from the outer surface of the ilium, beneath its crest, to the broad truncated upper surface of the trochanter. In PHOCA it was small from the hinder and under surface of the ilium to the top of the trochanter.

*Glutæus minimus* (ORYCT.) scarcely distinguishable from the preceding, In PHOCA it was large, passing from the concave hinder surface of the ilium to the fore part of the great trochanter.

*Pyriformis*, in both, as in man. *Obturatores*, large. *Gemelli* were disposed in ORYCT. as in man, but were scarcely distinguishable from the obturators in PHOCA. *Quadratus femoris*, not a distinct muscle in either.

*Biceps flexor cruris* (ORYCT.) consisted of one portion only, passing from the posterior inferior spine of the ilium, the ilio-sacral ligament, and the lateral part of the sacrum, to the lower part of the back of the leg, where it blended with the tendo Achillis and was inserted with it into the os calcis. (Pl. iv.) In PHOCA it consisted of two portions—(1), arising from the tuber ischii radiated into a broad muscle, the thin tendon of which was spread out over the fibula and fore part of the leg, reaching as low as the ankle; (2), a muscular strap from the under surface of the sacro-iliac ligament and sacrum crossed deeper than the

first portion and passed down to the outer malleolus and the sheaths of the extensor tendons of the foot<sup>1</sup>.

*Semimembranosus* (ORYCT.) from the broad outer surface of the tuber ischii and the side of the tail to the upper part of the inner side of the leg.

*Semitendinosus* (ORYCT.) arising from the tuber ischii above the semimembranosus, crossed the latter at an acute angle, and descended beneath it to the inner side of the leg. Its lower margin was attached strongly to the ligaments behind the inner malleolus.

In PHOCA I could not distinguish between these two muscles in any part of their course. They arose from the sides of the three foremost caudal vertebræ, their fibres meeting those of the opposite side above the tail. They formed a broad oblong muscle, the tendon of which was expanded over the upper half of the tibia.

*Popliteus*, in both, large and disposed as in man.

*Gastrocnemius* (ORYCT.) had three heads: (1) from the outer condyle of the femur with a sesamoid bone in its tendon; (2) from the inner condyle of the femur; (3) from the head of the fibula by a thin tendon. It formed a broad muscle covering the back of the leg; and its chief insertion was into the projecting point of the os calcis. The greater number of the fibres which arose from the fibula crossed beneath the rest of the muscle, and were inserted into the fascia at the back of the leg and the side of the tibia. Those fibres which formed the innermost part of the outer head and so corresponded with the *Plantaris* of man were placed deeper than the rest of that belly in the leg; and the greater number of them crossed behind it to its inner side, passed by the inner side of the tendo Achillis, expanded upon the extremity of the heel-bone covering the insertion of the tendo Achillis into it, and were continued into the plantar fascia. This plantar fascia was disposed much as in man, and was connected with the sheath of the flexor tendons, and so with the heads of the metatarsal bones and the

<sup>1</sup> The continuation of the tendinous fibres of the biceps into the sacro-sciatic ligament of man is a representative of this second origin of the muscle in the Seal, and of the similar origin in *Orycteropus*.



phalanges. The deeper portions of each division, however, except in the case of that to the pollex, split and passed on either side of the deep flexor tendon; (just as do the divisions of the short flexor in man which they no doubt represent) to be inserted into the base of the second phalanx. It may be added, that having passed to the upper surface of the tendon, in each instance, they united, thus quite embracing it, and again separated.

In PHOCA the *Gastrocnemius* arose as usual from the condyles of the femur and the inner margin of the upper part of the tibia, and had no connection with the fibula. Its tendo Achillis was inserted into the heel-bone. The inner and deeper portion of the outer head formed the *Plantaris*. This was a distinct muscle beneath the gastrocnemius. Its tendon passed over the heel on the inner side of the tendo Achillis and was continued into the sole, where it formed a fascial expansion beneath that of the gracilis, and closely connected with the expansion of the flexor digitorum. The greater part of it, however, was, on the left side, continued as the superficial flexor tendon of the 4th and 5th digits. On the right side it formed the superficial flexor of the 4th digit only, the superficial flexor of the 5th digit, on this side, being derived from the gracilis. (Pl. VI.)

The disposition of the plantaris in these animals, and especially in *Orycteropus*, indicates that it is in them the homologue of the plantaris, plantar fascia and flexor digitorum brevis of man and that it, and therefore these three, may be regarded as serially homologous with the palmaris, the palmar fascia, and the flexor digitorum sublimis of the fore limb. The tendency of the latter muscle to disappear, as observed in these animals and especially in the Seal, is in harmony with the more or less complete absence of the muscular fibres of the flexor digitorum brevis; and its close connection with the flexor profundus in the Seal is in interesting harmony with those offsets of the flexor digitorum pedis in that animal (see below), which represent parts of the flexor brevis.

*Tibialis posticus* (ORYCT.) from the back of the tibia and the back of the head of the fibula. It descended in two tendons on the inner side of the tibia. Of these the superficial, from the tibial part of the muscle, sent a slip to the flexor digitorum, and another to the plantar fascia, and was continued along the

inner side of the navicular and cuneiform bones to the inner side of the head of the first (hallux) metacarpal, sending a slip on to the inner side of the base of the first phalanx. The deeper tendon, from the fibular part of the muscle, was inserted into the hinder part of the scaphoid bone. (PL. IV.) In PHOCA it arose from the interosseous ligament and the tibia, beneath the flexor digitorum. It was inserted (1) into the scaphoid; (2), by a distinct slip, into the inner side of the proximal part of the 1st metacarpal; (3) a considerable portion of its tendon extended into the ligaments under the tarsus and into the tendinous structure which represents the short muscles of the hallux. (PL. VI.)

*Flexor digitorum* (ORYCT.) large from the head and back part of the fibula, in the place of the fl. long. poll. of man, from the deep interosseous space and the inner edge of the tibia by an expansion covering the tibialis posticus. It passed beneath the annular ligament, formed a broad thick tendon in the sole, which divided into five tendons passing to the terminal phalanges of the five digits, each presenting, as in the case of the fl. dig. prof. of the fore limb, a longitudinal slit previous to its insertion.

In PHOCA the *Flexor digitorum* descended the back of the leg in two bellies, one occupying the position of the flexor longus pollicis of man and arising from the back of the fibula, and the other that of the flexor digitorum and arising from the back of the tibia and also of the fibula, so covering the tibialis posticus. The former was much the larger, and its tendon passed over the groove in the backwardly projecting astragalus. The tendon of the latter portion accompanied that of the tibialis posticus behind the inner malleolus. The two tendons united into a broad flat band from which two tendons passed to each of the digits except the 5th. These tendons stood in the relation of superficial and deep flexor tendons. The superficial tendons were connected with the sheaths; and their deeper or upper strata passing in the sheaths, divided to give passage to the deep flexor tendons, were continued along the plantar surface of the first phalanges between the deep flexor and the phalanges, and were inserted into the base of the second phalanges.

In the case of the pollex the superficial tendon did not divide as in the other toes, but was inserted along the fibular side of the 1st phalanx, the prolongation of the tendinous representative of the flexor brevis pollicis being continued along the plantar surface of the phalanx between it and the deep flexor. The tendons of each muscle (fl. l. p. and fl. dig.) contributed some fibres to each of the tendons (with the exception presently to be mentioned), but the deep tendons were derived mainly from the flexor longus pollicis, the flexor digitorum being distributed chiefly to the superficial tendons. The superficial tendon of the 4th digit was in one foot, and that of the 5th in both, derived from the plantaris.

The typically complete arrangement of these flexors of the digits appears to be in three layers similar to and homologous with those of the corresponding muscles in the fore limb (p. 304). Thus the superficial layer consists of the *plantaris*, which forms the plantar fascia and is connected with the sheaths of the tendons of the deeper layers and with the fibrous tissue of the cutis. The middle layer consists of the *flexor brevis digitorum*, which passes to the second phalanges of the digits. The deepest layer consists of the *flexor longus digitorum* and *flexor longus pollicis*; these two, as in the fore limb, being rarely separate except in man; and even in him they are not completely separate, inasmuch as they are connected by a tendinous slip, the reminder and representative of the closer union in other animals. Moreover, the two superficial layers are variable as to the distinctness of their development. The middle layer often does not extend beyond the region of the foot. Often it is more or less blended with (it might be expressed arises from) the deepest, or, as in *Orycteropus*, with the superficial layer, or, as in *Phoca*, with both the deep and the superficial layers; and one or both of the superficial layers often fail to pass to certain of the digits, more particularly to the 1st or the 5th or to both. In *Phoca*, as we have seen, they do not pass to the 5th and pass to one side only of the 1st digit<sup>1</sup>. The continuity between the crural and pedal parts of the superficial layer, though interrupted in man at the heel, causing a division into plantaris muscle with tendon and plantar fascia, is commonly maintained in other mammals. The rule of the perforating relation of the tendons of the two deeper layers is observed with remarkable constancy in both limbs.

<sup>1</sup> It will be observed that in *Phoca* the components of the middle layer arise in both fore and hind limbs chiefly from the deep layer.

An interesting illustration of the homology of the flexor sublimis in the fore limb with the flexor brevis in the hind limb is presented in the Rabbit by the fact that one part of the former, that to the 5th digit, ascends no further than the carpus, where it arises as a fleshy belly from the sheath of the tendons.

*Lumbricales* (ORYCT.) from between the divisions of the flexor tendons to the radial sides of the phalanges;—absent in PHOCA.

*Accessorius* (ORYCT.) represented by a tendinous band passing from the outer side of the os calcis and joining the broad tendon of flex. dig. before its division. In PHOCA it was a considerable fleshy mass passing from beneath the groove of the peroneus longus to the tendon of the plantaris.

*Abductor and Flexor brevis hallucis* not present in either, or represented only by tendinous structure. The abduction of the hallux was effected to a greater or less extent by the tibiales muscles.

*Adductor hallucis* (ORYCT.) from the head of the middle metatarsal to the outer side of the first phalanx of the hallux; in PHOCA represented only by tendinous structure.

*Adductor minimi digiti* (ORYCT.) from the middle metatarsal near preceding muscle to inner side of first phalanx; absent in PHOCA.

*Abductor minimi digiti* (ORYCT.) as in man; absent in PHOCA. The abduction of this digit was in both effected mainly by the peronei.

*Interossei* were, in both, situated upon the two sides of the three middle metatarsals, and passing to the sides of the phalanges and the sheaths of the tendons served as adductors and abductors of the respective digits. I could scarcely distinguish which were 'dorsal' and which 'plantar.' That upon the radial side of the 3rd digit in the Seal was very indistinct.

*Tibialis anticus* (ORYCT.) from the usual position on the outer surface of the tibia and from the tendo patellæ, a broad muscle covering the extensor dig. It formed two tendons above the ankle. Of these, one was inserted into the internal cuneiform bone, and the other into the adjacent part of the 1st metatarsal. (Pl. III.) In PHOCA its disposition was much the same, the slip to the int. cuneif. was however much smaller than that to the metacarpal. (Pl. VI.)

*Extensor digitorum* (ORYCT.) arose by a strong tendon from the outer side of the fore part of the external condyle

of the femur and slightly from between the tibia and fibula. It divided into four tendons to the four outer toes. They were, however, peculiarly disposed. (Pl. III.) That to the 2nd digit divided on the instep into two, of which the outer passed to the outer side of that digit and the inner sent a slip to the ext. hallucis and then passed on to the inner side of the 2nd digit. The two portions to the 2nd digit then united, forming a tendinous expansion over the first phalanx. Part of this expansion was inserted into the base of the 2nd phalanx; while the narrow remaining superficial part was continued to the base of the terminal phalanx. The 2nd tendon passed to the inner side of the 3rd digit. The 3rd tendon divided; its inner portion passed to the outer side of the 3rd digit, and its outer portion to the inner side of the 4th digit. The 4th tendon passed to the outer side of the 4th digit and to the 5th digit. The tendons were disposed on the phalanges of the several digits in the same manner as on the 2nd.—In PHOCA it was disposed much as in man; and each of its tendons passed over the first phalanx in three bands joined by a web. The middle band was inserted into the 2nd phalanx, and the two lateral bands converged to the middle of the 3rd phalanx.

*Extensor longus pollicis*, in both, much as in man; except that in ORYCT. it received a slip from the ext. dig., and in the SEAL it passed on to the inner side of the head of the metacarpal over the insertion of the tibialis anticus, and then crossed back again to the outer side of the 1st phalanx, along which it ran to the 2nd phalanx.

*Extensor brevis digitorum* in both arose as in man. In ORYCT. it had three tendons, which passed to the three middle digits joining the long extensor tendons. In PHOCA it consisted of only two portions, of which one passed to the tibial side of the 2nd digit, and the other to the fibular side of the 4th digit.

*Peronei* in ORYCT. passed behind the outer malleolus in four tendons. One, from the outer part of the fibula, joined the extensor tendon on the outer side of the 4th digit; a second passed to the process at the outer side of the base of

the 5th metacarpal; and a third passed to the outer side of the first phalanx of the 5th digit. The last two arose from the part of the fibula occupied in man by the peroneus brevis and tertius. The fourth (*peroneus longus*) followed its usual course to the outer side of the base of the 1st metatarsal, but sent a slip to the inner side of the base of the 5th metatarsal; and hence it adducted, or drew towards another, these two toes.

In PHOCA the *Peroneus longus* was attached to the outer condyle of the femur<sup>1</sup> as well as to the fibula. It passed in front of the outer malleolus, then, in a deep groove in the os calcis and the cuboid to the 1st metatarsal. Two other peronei, from the outer and back part of the upper two-thirds of the fibula, descended behind the outer malleolus, crossed beneath the peroneus longus, and passed, one to the base of the 5th metacarpal and the other to the base of the outer side of the first phalanx of the 5th digit.

The effect of all the peronei is to abduct the whole foot; and the two short peronei are the main agents in expanding the paddle.

#### NECK AND TRUNK.

*Sterno-mastoid* (ORYCT.) from sternum and inner fourth of clavicle to mastoid; a slip detached from the sternal portion formed the depressor auris. In PHOCA it was a thin muscle arising from the margin of the episternum, and inserted by a small tendon into the mastoid process<sup>2</sup>.

*Sterno-hyoid* (ORYCT.) as in man. In PHOCA, as it descended from its usual position on the hyoid, where some of its fibres were continuous with the genio-hyoid, it spread out, fanlike, and was attached to the sternum, to the inner tubercle of the humerus and to a fascial band (a representative apparently of the costo-coracoid aponeurosis) extending between these two.

This disposition of the muscle shows pretty clearly that the omohyoid in Man is a derivative from the sterno-hyoid, that is to say, is

<sup>1</sup> Meckel does not mention this attachment in the Seal, though he observed it in some other carnivora. (*l. c.* 628.)

<sup>2</sup> Meckel did not observe this muscle, and therefore supposed the sterno-mastoid to be absent in the Seal. (*l. c.* III. 424.)

the homologue of the outer portion of this 'sterno-omo-hyoid' of the Seal.

*Sterno-thyoid*, *Mylo-hyoid*, *Genio-hyoid*, *Genio-hyo-glossus*, *Hyo-glossus*, *Stylo-glossus*, *Stylo-hyoid* (in ORYCT.), and *Masseter* in both much as in man.

*Digastricus*, in both, from the mastoid process to the angle and lower margin of the jaw. Near its middle it presented, in the Seal, a superficial transverse tendinous division which is probably the representative of the more distinct tendinous division in man<sup>1</sup>. In this animal a portion of it arose from the tympanic bulla close to the styloid process, and seemed to be the representative of the stylo-hyoid.

*Pterygoid*, in PHOCA, formed one muscle arising from the outer side and edge of the slightly developed pterygoid part of the sphenoid and passing to the inner side of the angular part of the jaw.

*Tensor palati*, in PHOCA, arose from the sphenoid close to the anterior and outer part of the tympanum, external to the Eustachian tube, passed round the groove in the slightly projecting single pterygoid plate, and expanded into the palate.

*Levator palati* (PHOCA) from the anterior surface of the bulla, near the preceding, radiated into the palate.

The Eustachian tube just admitted an ordinary probe. Though close to these muscles, it was clear that they could act upon it or influence the condition of its orifice or tube.

*Scalenus* (ORYCT.) one large muscle descending from the cervical transverse processes down in front of the serratus as low as the 6th rib. In PHOCA it divided as it descended into two portions, of which one was attached to the first rib above the pectoralis minor and the other into the 4th and 5th ribs above the digitations of the serratus magnus.

<sup>1</sup> In the Guinea-pig, where the muscle passes further forward, nearer to the symphysis, the tendinous division is still more marked, involving the greater number of the fibres; yet the muscle has nearly a straight course from its origin to its insertion.

## DESCRIPTION OF THE PLATES.

Plate III. ORYCTEROPUS. The integuments have been removed from the left side of the neck and the outer part of the left arm and fore-arm, to display the platysma myoides. A deeper dissection of the right arm and palmar aspect of the fore-arm and paw, and of the right leg and foot are also shown.

*Pl. m.*, platysma myoides. *Sup. l.*, supinator longus.

*Depr. aur.*, depressor auris. *Attr. aur.*, attrahens auris. *Depr. lab. inf.*, depressor labii inferioris. *Bucc.*, buccinator. *Lev. lab. s.*, levator labii superioris. *Lev. n.*, levator nasi.

*D.*, deltoid. *Pect.*, pectoralis major, cut fibres of. *B.*, biceps. *C. br.*, coraco-brachialis. *Tr.*, triceps. *L.*, lumbrici. *Fl. c. u.*, flexor carpi ulnaris. *Sup. l.*, supinator longus reflected. *Pr. t.*, pronator teres. *Fl. c. r.*, flexor carpi radialis. *Fl. d. s.*, flexor digitorum sublimis. *Fl. d. p.*, flexor digitorum profundus.

*Tib. a.*, tibialis anticus. *Ext. d.*, extensor digitorum longus. *Ext. p.*, extensor pollicis. *Per. l.*, peroneus longus. *Per.*, peronei. *Ext. d. br.*, extensor digitorum brevis. *T. p.*, tibialis posticus.

Plate IV. Dissection of the muscles on the anterior aspect of Orycteropus.

(Left Side.) *Mas.*, Masseter.

*Attr. aur.*, part of attrahens auris to lower jaw beneath condyle.

*Depr. aur.*, depressor auris descending on anterior surface of (*St. m.*) sterno-mastoid. *Ext. jug.*, external jugular vein. *Trap.*, trapezius. *C. h.*, cervico-humeral.

*D. D.*, deltoid. *Subcl.*, subclavius. *Tri.*, triceps. *Sup. l.*, supinator longus. *Sup. b.*, supinator brevis. *Ext. c. u.*, extensor carpi ulnaris. *Ext. min. d.*, extensor minimi digiti. *Ext. ind.*, extensor indicis. *Ext. ann.*, extensor annularis. *Ext. p.*, extensor pollicis. *Ext. d.*, extensor digitorum. *Ext. c. r.*, extensor carpi radialis. *Ext. ind.*, extensor indicis.

*S.*, sartorius. *Add.*, adductors. *V. i.*, vastus internus. *Gr.*, gracilis. *T. p.*, tibialis posticus. *T. a.*, tibialis anticus. *Pl. f.*, plantar fascia. *Fl. d.*, flexor digitorum. *Pl.*, plantaris. *Gastr.*, gastrocnemius. *S. memb.*, semi-membranosus.

(Right Side.) *Digast.*, digastricus. *Thyr. h.*, thyro-hyoid. *St. h.*, stylo-hyoid. *St. th.* sterno-thyroid. *St. h.*, sterno-hyoid.

*C. br.*, coraco-brachialis. *B.*, biceps. *D.*, part of deltoid that joins biceps. *P.* pectoralis major. *P. min.*, pectoralis minor.

*Fl. d. s.*, flexor digitorum sublimis: of the division to index finger the superficial part connected with sheath of tendon remains; the strong transverse straps are also seen; in the case of the other fingers the superficial part and the transverse straps have been re-



moved, showing the remainder dividing and giving passage to the tendons of the deep flexor.

*Fl. c. r.*, flexor carpi radialis. *Fl. d. p.*, flexor digitorum profundus. *Pr. t.*, pronator teres. *Fl. c. u.*, flexor carpi ulnaris. *Tr.*, four portions of the triceps. *Subsc.*, sub-scapularis. *T. m.*, teres major. *Scal. ant.*, scalenus anticus. *Subcl.*, sub-clavius. *Pect. min.*, pectoralis minor. *Pect.*, pectoralis major.

*Obl. e.*, obliquus externus.

*Gl.*, glutæus maximus. *S.*, sartorius. *Pect.*, pectineus. *Gr.*, gracilis.

Plate V. Dissection of the muscles on the posterior aspect of *Orycteropus*.

The *left side* shows the more superficial muscles.

*Attr. aur.*, attrahens auris. *Lev.*, levator auris. *Retr.*, retrahens auris.

*Trap.*, trapezius. Cervico-humeral is drawn aside by a hook.

*Tri.*, triceps.

*Lat. d.*, latissimus dorsi.

*Gl.*, glutæus maximus.

The *right side* shows the deeper muscles.

*Temp.*, temporal muscle. *Spl.*, splenius. *C. h.*, cervico-humeral.

*Lev. sc.*, two portions of levator scapulæ. *Rh. min.*, rhomboideus minor.

*Ext. d.*, extensor digitorum. *Ext. c. r.*, extensor carpi radialis. *Sup. l.*, supinator longus. *D.*, deltoid, the portion of the deltoid inserted into the humerus divided and reflected.

*T.*, the terminal part of (*Tri.*) the scapular division of the triceps reflected to show its insertion into the distal part of the olecranon. *Tr.*, the humeral division of the triceps inserted into the upper part of the olecranon.

*Subcl.*, sub-clavius appearing from beneath the clavicle and attached to the fascia covering the supra-spinatus.

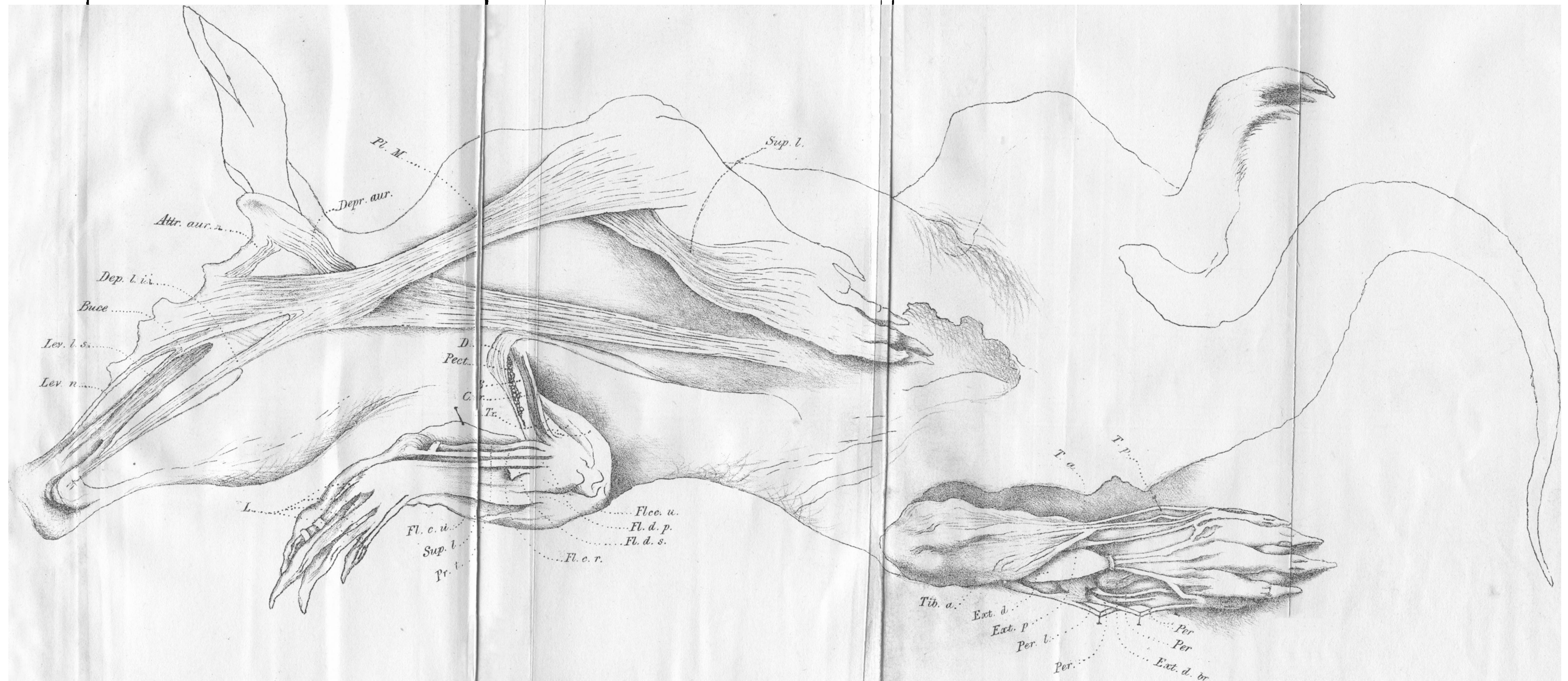
*T. min.*, teres minor. *S. sc.*, supra-scapularis.

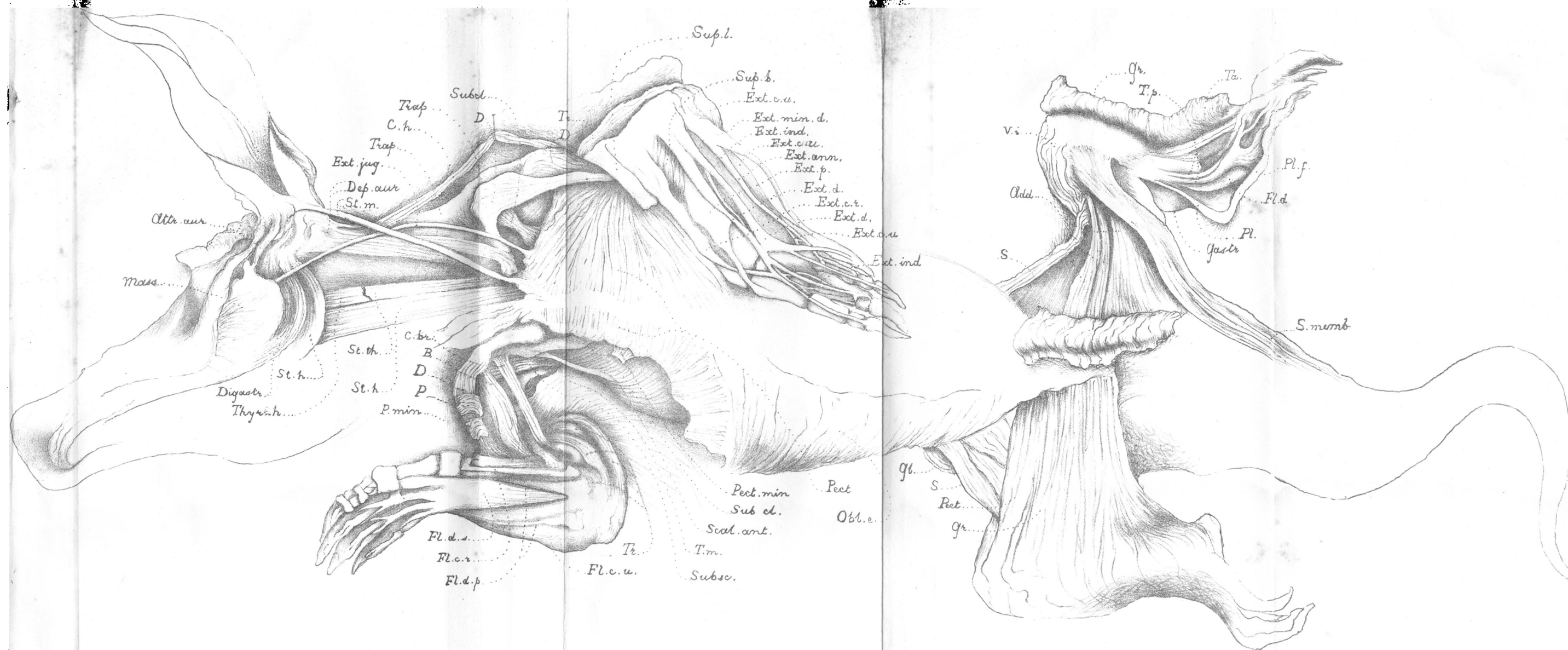
*Serr.*, serratus magnus anticus. *Rh.*, Rhomboideus. *Long. d.*, longitudinalis dorsi. *S. l.*, sacro-lumbalis.

*Gl. med.*, glutæus medius. *Gl. m.* (1), origin of glutæus maximus from margin of ilium beneath the anterior superior spine. *Gl. m.* (2), deeper portion of glutæus maximus attached to femur and expanding over knee. The proximal part, or origin, has been removed.

*S. memb.*, semi-membranosus. *S. tend.*, semi-tendinosus. *V. ext.*, vastus externus. *R.*, rectus femoris arising from ilium. *Bi.*, biceps flexor cruris. *Gastr.*, gastrocnemius.

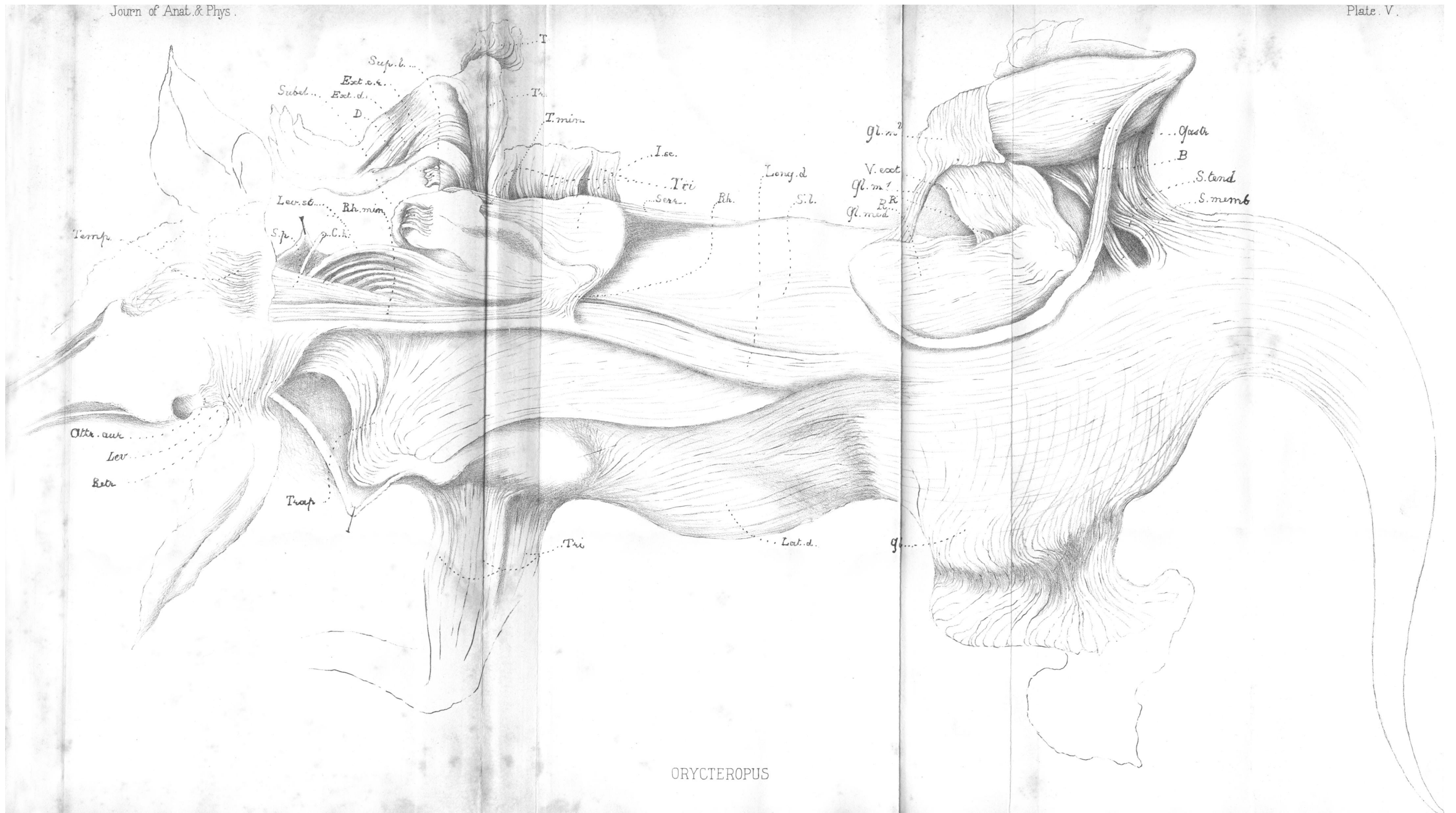
Plate VI. SEAL. Fig. 1. Muscles on hinder aspect, letters as above. Fig. 2. Muscles on anterior aspect. Fig. 3. Muscles of face and ear.





OYRCTEROPUS CAPENSIS.





ORYCTEROPUS



Fig. 1.

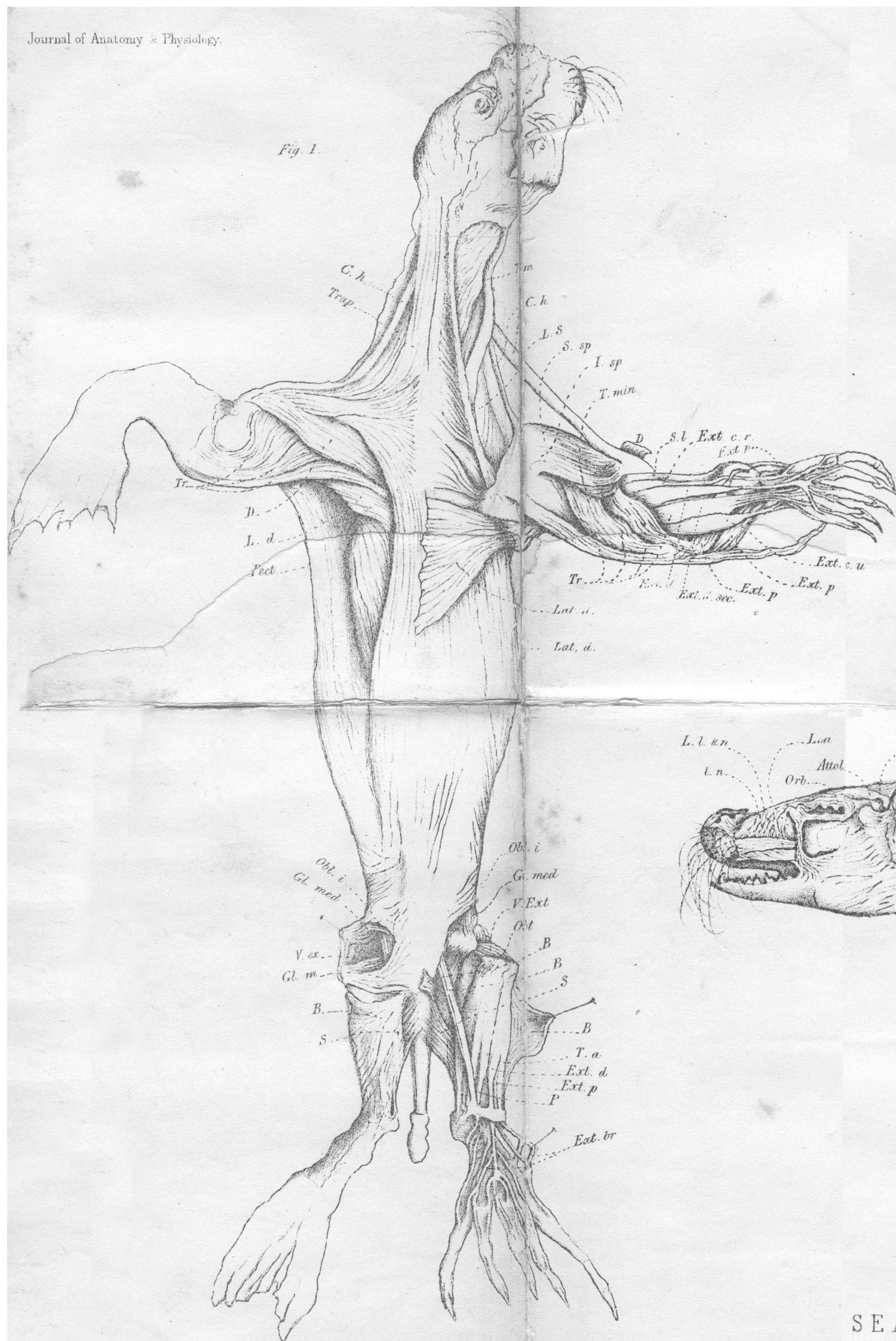


Fig. 2.

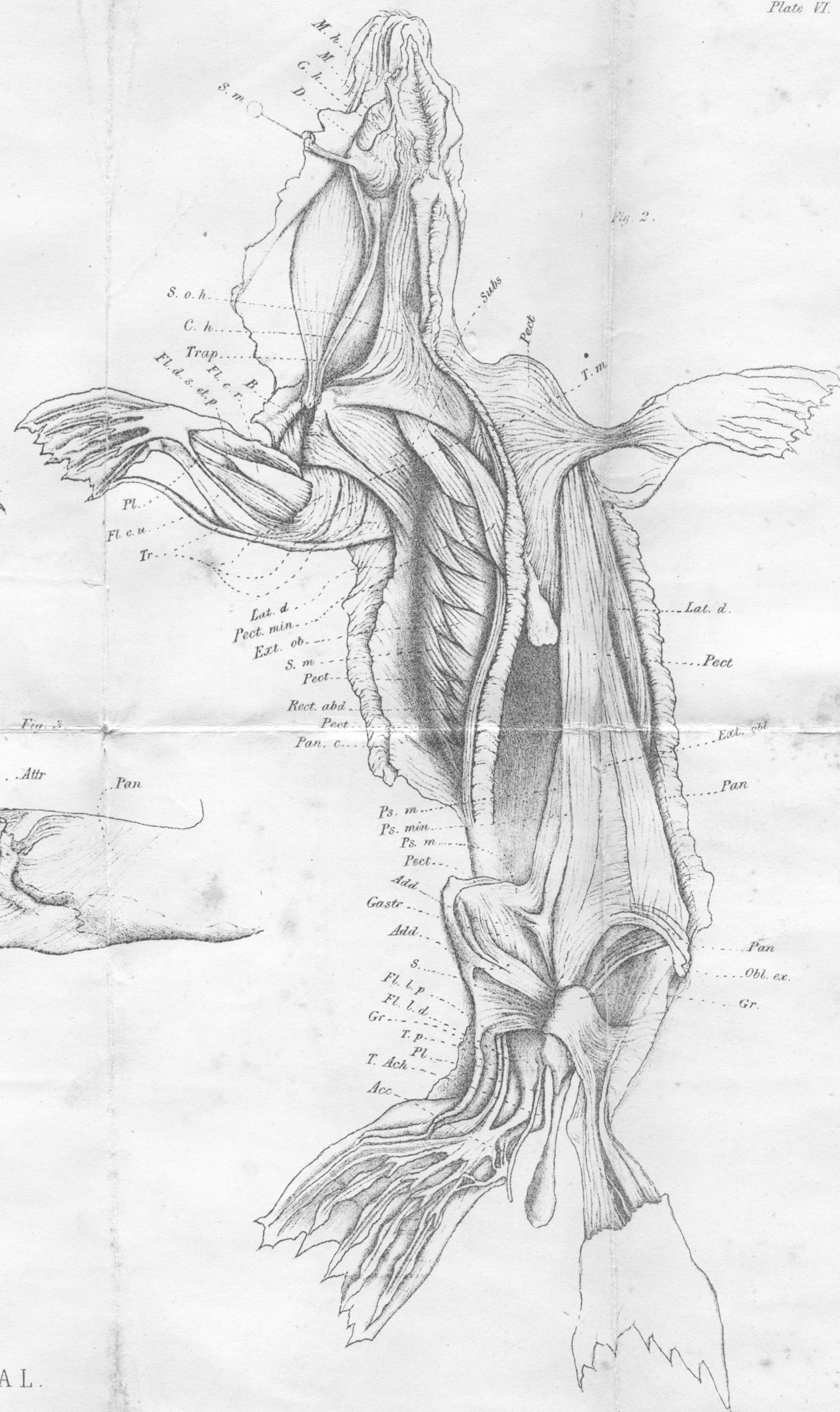


Fig. 3.

